PIPING INSTALLATIONS IN BUILDINGS

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THE SUPERINTENDENCE

OF

PIPING INSTALLATIONS IN BUILDINGS

Sanitary, Hydraulic, and Gas

By

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etc., etc.

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PREFACE

THE book has grown out of a series of articles contributed, some years ago, by the author, to an architectural publication. The articles have been revised and brought up to date, and considerable new matter has been added.

The rules, suggestions, and observations are based upon a practical experience of more than twenty-five years in this branch of building construction and sanitation.

The aim throughout has been to deal with the subject from a practical point of view only. Purely theoretical considerations are purposely omitted as they may be found in other works by the author, to some of which reference has been made.

The book is intended chiefly for the younger men beginning actual practical work, for architectural superintendents, as well as for plumbing and health inspectors, and for the superintendents and foremen of plumbing firms. Property owners who build houses and who prefer to look after the plumbing and sanitary work themselves — parenthetically I may state that there are quite a number of these — should find the book a useful guide.

THE AUTHOR.

February 25, 1907.

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THE SUPERINTENDENCE OF PIPING INSTALLATIONS IN BUILDINGS.

INTRODUCTION.

IN executing sanitary, hydraulic and gas piping work in buildings, something more than correct, complete and detailed plans and a carefully drawn-up specification are required: it is necessary that during the entire construction of the work the same be properly *superintended.*

Superintendence is required, *first*, to make sure that the plans are followed, that the materials and appliances specified are actually used, that the workmanship is of a proper character, of the highest grade, where it is the intention of the specification and of the contract to secure this, and of a thoroughly good kind, where a plain, inexpensive, substantial but sanitary job is called for.

Superintendence is necessary, *secondly*, to establish a close relationship between the architect of the building and the contractor, for no matter how accurate and correct the specification may be drawn, no matter how detailed the plans and sections are worked out, numerous questions arise in practice *in every job*, whether large or small, costly or inexpensive, regarding which the contractor's foreman will require instructions or explanations, in order to be able to follow the plans and specifications "according to their true intent."

Superintendence is, *thirdly*, required, in directing and witnessing the different tests to which now-a-days all hydraulic, sanitary and gas fitting work is subjected, no matter whether the building is a tenement house or a millionaire's mansion.

Superintendence is also necessary in order to foresee changes from the plans due to structural reasons so as to avoid "extras." It is likewise required in order to keep a proper record of any work omitted with the architect's approval, and for which a proper credit should be given by the contractor.

It is often erroneously supposed that with the inspection given to modern work, at least in the larger cities, by building, plumbing, or health inspectors, a close supervision of this work on the part of the architect or of his office staff is rendered unnecessary. No greater mistake than this is possible. For it should be remembered that city plumbing ordinances are, without exception, framed so as to secure satisfactory sanitary results with the cheapest permissible class of work and material. Where general laws are passed intended to govern such work, it is always with the intent of establishing a *minimum standard*. It would be obviously out of the question to enforce, by laws, a different standard of workmanship and material in the houses of the wealthy than in the cheaper types of homes or in plain stores and warehouses.

On the contrary, in both cases cited one and the same building department specification is used, the same rules are applied, the same amount of inspection is given, hence it follows that the very highest results in sanitation cannot be reached by simply using the building department blank specifications and trusting to the casual supervision of an

official inspection as to the proper execution of the work. As a matter of fact these official inspections are carried out in some of our large cities in a very inefficient and careless manner.

Where a higher grade of work is expected — and I incline to the belief that this should be secured in *every* instance — proper and constant supervision is required.

It cannot be expected that a busy architect should visit a building in course of construction more than twice a week. He will be guided in the number of his visits by the kind of work and the cost of the building; the character of the contractor employed by the owner will also naturally govern him in the attention given to secure his client's satisfaction.

In important cases, the sanitary, hydraulic and gas piping work, as well as the electric and heating and ventilating work, are, as a rule, now-a-days, entrusted to specialists, to expert engineers in their respective branches of the work. In other cases, where more than the usual architect's supervision is expected, a clerk of works or building superintendent is engaged, whose duty it is to give special attention to the general construction, but also to all those numerous minor details which it is impossible for an architect, having at one time several buildings in charge, to follow up.

The schedule for the professional practice of architects, adopted by the American Institute of Architects, defines *supervision* as follows:

"The supervision or superintendence of an architect (as distinguished from the continuous personal superintendence of a clerk of the works* means such inspection by the architect, or his deputy, of a building or other work in process of erection, completion, or alteration as he

* Or that secured by the engagement of the services of a sanitary, heating or electrical expert. W. P. G.

finds necessary to ascertain whether it is being executed in conformity with his designs and specifications or directions, and to enable him to decide, when the successive installments of payments are due or payable, as provided for in the contract or agreement. He is to determine in constructional emergencies, to order necessary changes, and to define the true intent and meaning of the drawings and specifications, and he has authority to stop the progress of the work and order its removal when not in accordance with them."

"On buildings where it is deemed necessary to employ a clerk of the works, the remuneration of said clerk is to be paid by the owner, or owners, in addition to the commission or fee due to the architect. The selection or dismissal of the clerk of works is to be subject to the approval of the architect."

In the dictionaries, we find superintendence defined as "the act or right to superintend, the guiding and controlling, the supervision or oversight, the general inspection of the work, the direction and management, the watchful care and rule, the inspection." Supervision is defined as "the act of superintendence." No particular distinction seems to be made in the meaning of the two words.

The following pages are intended as a helpful guide for clerks of works in superintending a building. While the points discussed are, probably, more or less familiar to men in long practice, it is believed they will be useful to the younger men of the profession, and will serve to answer many questions constantly recurring to all engaged in building construction, and particularly in the sanitary, hydraulic and gas piping branches.

The subject of superintendence will be discussed, as nearly as possible, in the relative order in which such work is usually carried out in city buildings, viz.:

1. Sewer, water and gas connections.
2. Gas piping.

3. Rough work, drain, soil, vent and leader system.
4. Water pipes, pumps, tanks, etc.
5. Roughing for the plumbing fixtures.
6. Setting up and connecting the plumbing fixtures.
7. Completing the work, turning on the water and gas.
8. Tests.
9. Records and plans.

I.

SEWER, WATER, AND GAS CONNECTIONS

1. *The sewer connection or connections (where more than one is called for) must be properly located according to the drainage plan; any deviation from same, made necessary by existing unavoidable conditions, should be recorded on the plans for future reference.*

Unless good and sufficient reasons are given, the superintendent should not permit the sewer connection to be made in a different location from that shown on the plans. As a rule, where the plans show the drainage, the mason will leave out arched holes in the foundation walls, for the sewer pipe to pass through, or build pipe sleeves into them. A change in the location of the sewer connection frequently means extra work for the mason in cutting new holes. In some cases a change might require the sewer to run through a pier which, for obvious reasons, would be improper.

2. *The sewer connection to be made of proper size.*

The size of the house sewer is usually determined by the size of the lot and building to be drained. In some cities, the municipal departments govern by rules the size of the sewer to be used. Without good and sufficient reasons the contractor should not deviate from the size shown on the plans or called for in the specifications.

3. *The grade of the house sewer, both inside and outside of the house, to be carefully determined by levels, before pipe laying is commenced.*

Though the depth of the street sewer is usually given in the engineer's survey of the lot, a careful workman should always, before commencing actual work, ascertain the available fall from the highest point of the drainage system to the connection with the street sewer. The superintendent should, wherever his duties permit, check the levels taken by the contractor's foreman, in order to avoid establishing a wrong grade. It should be noted that the surveys give the depth of the inner flow line of the sewer below the curb, and that the connection must in the case of brick sewers be made *at least* one foot higher than this level.

4. *The house sewer to be laid with proper fall, and the fall to be continuous.*

It is a common experience to find that workmen, in order to save some excavation or the taking out of some rock in the sewer trench, will distribute the available fall unevenly, and run the house sewer with a steep grade from the outer house wall to the street sewer. The superintendent should not permit this, but should see to it that the total fall is *evenly* distributed throughout the entire length of the house sewer.

5. *Where the available fall from the house to the sewer is deficient, proper flushing arrangements should be provided.*

This is a necessary precaution which is only too often neglected. When it happens that the house sewer, for some reason, cannot be laid on a grade which would render it self-cleansing, it becomes necessary to provide some means for artificially flushing the same. In the case of city houses this is not usually required. But should the superintendent happen to find a case where the fall of the house sewer is insufficient to create a velocity of flow which will prevent deposits, he should take note of it, and report the fact to

headquarters, so that some means for flushing (by self-acting flush tank or otherwise) can be devised and installed.

6. *The house sewer to be of proper material as specified.*

Usually the sewer connection is made of glazed or vitrified sewer pipe, and if the conditions are favorable there is no better material available. In made ground, however, it is better to use heavy iron pipe for the entire distance from the house to the street sewer. In New York City, this is the common method. Should the specification call for earthen pipe and the superintendent find that, for good reasons, iron pipe would be preferable, he should report the fact without delay to the office so that the proper change can be made. If in the case of country residences the house sewer should pass near a well for drinking water, or near the roots of trees, the outside sewer should also be made of heavy iron pipe. All cast iron pipe sewers should be painted two coats after being laid in the trench.

7. *Proper attention should be given to the making of the pipe joints.*

Careless workmen often neglect to make permanently tight joints in the house sewer outside of the house, assuming that any leakage in this part of the work will not be harmful nor be detected. Where iron pipe is used the joints should be leaded and caulked with the same care as the joints of inside pipes. Vitrified pipes must have well-made cement joints, and attention should be given particularly to the inside of the pipe joint which should be kept free from protruding cement. In the best work the superintendent should require the length of the outside house sewer to be filled with water to test the tightness of the joints. In ordinary work this precaution is frequently neglected.

8. *Proper provision to be made for manholes, lampholes, handholes for inspection, etc.*

In the case of city houses the distance from the house walls to the street sewer rarely exceeds thirty feet (very wide streets excepted) and the necessity for manholes does not exist. For country houses, where the outside sewer is sometimes of great length, manholes and lampholes should be provided at distances of about 100 feet, and they should be rendered easily accessible by iron covers, and by having iron steps built into them.

9. *The connection with the sewer in the street to be made in a workmanlike manner.*

Great carelessness often prevails in making this connection, notwithstanding the fact that in cities the work is inspected by special inspectors of the sewer department. Where the sewer is a brick sewer, the connection should be made at or above the spring line of the sewer arch; it is best to use one of the special vitrified slant connections made by pipe manufacturers, so as to make the house sewer enter the main sewer under an oblique angle to the flow. Careful sewer regulations provide this, but in New York and Brooklyn, for instance, the connection is always made at right angle to the sewer. I have never yet met a municipal inspector who would suggest or insist upon a connection in the shape of a Y-branch. In making new sewer connections with pipe sewers it is common to find the "spurs" or branches already provided for in the line of the street sewer. In this case the connection is made at the line of the axis of the pipe. Sometimes it happens that the diameter of the branch is smaller than the size of the house sewer. The superintendent should not, in this case, permit the use of a reducing fitting, but should insist upon

the spur being changed by the sewer department to one corresponding to the size of the house sewer. In no case should clumsily made or imperfect connections with the street sewer be tolerated.

10. *The water connection or connections (where several taps or services are required by the specifications) to be properly located, and to be made of size as called for. See that openings are left in the front cellar wall for the pipes to pass through.*

Where the point at which the water service is to be introduced into the building is marked on the plans, the contractor should place his service connection in accordance with the measurements given, unless a good reason exists for deviating from this location. The superintendent should see that the proper size of tap is obtained by the plumber from the Water Department. In New York City, the usual size of tap for a dwelling house is $\frac{5}{8}$ inch, and unless a water meter is used in the house, no larger tap is given. But, even where such a size of tap is used, it is a good plan to enlarge the service immediately behind the tap, as this secures a better supply of water to the house.* In New York it is permissible to run any size of service pipe from the tap into the house. In Brooklyn, however, not only the size of the tap is controlled by the Water Department, but also the diameter of the service up to the house or building line. Thus the usual size of tap for houses up to twenty feet front is only $\frac{3}{8}$ inch, and the service pipe must not be larger than $\frac{1}{2}$ inch. For small houses this may answer the purpose, provided there is a good pressure of water in the mains; but for larger

* See the author's article on the discharge of service pipes and taps in *Cassier's Magazine* Vol. 29, p. 22.

houses this inevitably leads to the result that when water is drawn in the basement, the flow of water at faucets in the upper stories is almost, if not entirely, stopped.

EXAMPLES

(*Based upon the diagrams in the above quoted article*).

A four-story city dwelling receives its water supply through a $\frac{5}{8}$-inch corporation tap and a $\frac{3}{4}$-inch service pipe, 58 feet long. The water pressure is 25 pounds per square inch and the quantity of water delivered is 890 gallons per hour. A $\frac{3}{4}$-inch tap and service, other conditions remaining the same, would furnish 940 gallons per hour.

If the house is a larger one and provided with more than the usual plumbing, we may run a 1-inch service pipe into the building, use a 1-inch tap and set a meter. We then obtain a delivery of 1900 gallons per hour.

If we wish for a still larger supply, we use a $\frac{5}{8}$-inch tap and $1\frac{1}{4}$-inch service, and obtain under the same pressure of 25 pounds, and for a length of service pipe of 58 feet, 2280 gallons per hour.

Suppose we are dealing with a large building. The pressure in the street main is 35 pounds and we wish to deliver 3000 gallons per hour under a pressure of 25 pounds, the service pipe being 58 feet long. The head lost being 10 pounds we find from the diagrams referred to in above footnote as follows:

A $1\frac{1}{2}$-inch pipe and $1\frac{1}{2}$-inch tap will give 3360 gallons per hour. Or we may obtain two (2) $1\frac{1}{4}$-inch pipes with $\frac{5}{8}$-inch taps and receive from each 1430 gallons, or from the two 2860 gallons per hour. Or else we may use one 2-inch service and 1-inch tap and obtain 4150 gallons per hour.

11. *Proper material should be used for the house service pipes.*

The specifications usually call for either lead or galvanized iron water pipe connections. Lead is in many respects the best material for street water connections, but the superintendent should see to it that the lead pipe be of the proper grade, either "AA" or "AAA," as may be specified. If galvanized iron pipe is used, this should be painted outside as a protection against the corroding influence of some kinds of soil. Brass pipe, tinned on the inside, is not often used for street service connections.

12. *Proper provision to be made in the arrangement of the service pipe connection with the tap in the street main for settlement.*

Notwithstanding all precautions in refilling the trenches, settlement may occur, and should the connection be made too rigid, the service may break off at the main tap. If lead is used, a bow or loop should be provided at the connection with the tap which will guard against breakage. Even where the service consists of iron pipe, there should be inserted a short length of lead pipe between the tap and the iron pipe, or else a loop made of iron fittings. Even the larger water connections (above two inches) are seldom made rigid, and in all cases extra care is advisable in filling up the trenches. When completed the water supply service should be tested in the superintendent's presence under hydrostatic pressure.

13. *A gas service pipe of proper size (or several companies' services if required) to be run into the building at the point indicated by the superintendent.*

Gas companies, at least in New York City, seldom refuse to grant any size of service required by the architect for a

building. The size is, of course, determined according to the expected consumption of gas, *i. e.*, the number of gas lights, the number and size of the fireplace gas logs, and the size of the ranges for cooking by gas and for doing the work in the laundry. Where there are in one street the service mains of several companies, it is advisable to request at least two companies to put in their house branches, as the owner may, at some future time desire to change the company which supplies him with gas. The gas service should be tested by turning on the gas before the trench is closed.

14. *The superintendent should see that the gas and water services are provided with shutoffs located in an easily accessible position in the sidewalk.*

In New York City the Water Department does not insist, as is the case in many other cities, upon the service being provided with a shutoff to cut off the water from a building from the outside. It is, however, an excellent precaution to provide for this. Shutoffs on gas services are not usually put in, useful though they may prove to be, except the service is one and one-half inches or larger. The shutoff is, however, always required by law in the case of theatres and places of assembly. In this case the law stipulates that the stopcock or valve should be placed in the sidewalk near the curb, for if placed in the street pavement it may not be accessible during winter time, when covered up with snow, for instance. It is, to my mind, better to place all such shutoffs in the sidewalk notwithstanding the fact that they may require extra holes to be cut in the case of sidewalks constructed of stone flags.

15. *All trenches for sewer, water, and gas pipes to be properly refilled, and the earth used in refilling the trenches*

to be well tamped or puddled to prevent subsequent settlement. The filling to be done with clean earth, sand, gravel, or loam, and no stones to be used immediately over the pipes.

This requirement is almost self-evident, still it is one which in the building practice is constantly violated, and it will require special vigilance on the part of the building superintendent to enforce the rule. In refilling, the earth should be deposited in layers not exceeding nine inches in depth, and each layer should be well rammed with heavy wooden or iron tampers. It is a bad practice to allow the lower part of the trench to be filled up with stones taken out of the same.

16. *Always locate sewer, water, and gas connections, when completed, on the plans, particularly the points at which they enter a building. Also record the height from the finished cellar floor to the center or axis of the various pipes.*

The superintendent can easily take these records, which it is of importance to keep for future reference. Many questions will arise during the subsequent construction of the plumbing and drainage, heating and electrical work, for which it is of value to be able to use these records.

II.

GAS PIPING.

WHEN the sewer, water, and gas connections for a building are made, the first work usually required is the running of the gas pipes. It is desirable to finish at least the main runs before the first or rough floor is laid; it is also necessary that the entire gas piping should be completed before the plastering is begun.

It is not the intention to dwell here upon all the points which a young superintendent should know about the arrangement of the gas piping, but merely to call attention to some of the more important ones. For more complete information he should study one of the elementary works on gas fitting and gas lighting.*

17. *See that the piping and the fittings for gas are of the proper material, and that shutoffs are provided where necessary or called for.*

In this country wrought iron pipe is the material universally used for gas piping. It is in every respect superior to lead pipe which is sometimes used in England and on the Continent of Europe. A great deal of butt-welded steel pipe is now sold in the market, which is inferior to wrought iron, being more brittle and harder to cut and thread. The superintendent should ascertain that none of the cheaper material is used. Even where the specifications do not dis-

* See Gerhard, "Gas Lighting and Gas Fitting," in the Science Series, price 50c.; also his papers on "Dangers to Health from Illuminating and Fuel Gas," and his "Specifications and Rules for Gas Piping."

tinctly call for galvanized iron fittings, a good gas fitter will purchase these, and use them in preference to plain fittings, which often have sandholes, and cause much trouble and loss of time to the fitter when the gas piping is tested. I prefer using the malleable iron fittings which are stronger.

The superintendent should also observe that proper fittings are used, and that crosses are put in in place of elbows where there is a possibility of future additions to the gas piping. He should prohibit the use of common bushings, and require the use of the proper reducing fittings; this may cause a little trouble to the gas fitter in the beginning, but it secures a far superior job. Where shutoffs for gas are called for on the risers, or in some cases for each floor separately, the superintendent should see that these are put in.

18. *Gas pipes should be run with a proper fall to the riser or risers and the gas meter. At the foot of all risers provide proper drip plugs.*

This is one of the cardinal rules in piping buildings for gas. It is of particular importance where the house is to be supplied with machine gas, but all gas, whether coal or water gas, or machine gas, contains some vapor which condenses and which would trap and obstruct the pipes unless they are run with some continuous fall to the riser, so that the watery vapor, when condensed, may run back into the meter, and not into the fixtures. The drip plugs are useful in permitting the removal of a part of the condensation or of occasional stoppages.

19. *All gas pipes to be properly fastened and supported.*

This is required to prevent pipes from becoming loose, and to avoid sags in horizontal runs, also to make sure that the fixtures are sufficiently well supported.

20. *No beams should be cut, notched or bored by the gas fitter. In no case shall it be permitted to notch beams in the middle of their span so that the fitter may get short and direct connections for the ceiling lights in the center of the rooms.*

Wherever possible gas pipes should be carried on top of the floor beams, not at their bottom, except where ceilings are not plastered. In case of repairs it is easier to take up a few floor boards than to cut a plastered ceiling.

It is quite important that the superintendent should from the start make the gas fitter understand that he must not cut any beams, and that all required notching and cutting will be done for him by the framer or carpenter. The superintendent should instruct the latter that the notching shall not be farther than two feet away from the bearing of the beams, and not deeper than two inches. If attention is not given by him in time to this matter, he may find that the fitter has done irreparable injury to the beams of the building.

21. *Gas risers should not be placed in outer walls.*

It is always preferable to place risers for gas in minor closets and to keep them exposed, but where they must be hidden some inside partition should be chosen. This is of special importance in the case of country houses supplied with gas from an air gas machine, for a cold outside wall will cause the vapor to freeze in extremely cold weather.

22. *Gas pipe branches should not come from the bottom of running lines but from the sides or the top.*

This is another important precaution to which the superintendent should pay attention. The intention of the rule is to avoid any condensation in gas pipes from flowing down into the gas fixtures, which would soon become obstructed with naphthaline.

23. *No gas fitter's cement to be used on joints or at fittings.*

The superintendent should instruct the fitter at the beginning of the work that he must not use gas-fitter's cement, and that he will be expected to put all pipes and fittings together tightly with screwed joints, made "metal to metal," or else with the use of linseed oil or a paste of red lead. Gas fitter's cement is a very dangerous material to use, and any work so treated should be immediately condemned.

24. *Gas pipes must never be filled with water to tighten the joints by rusting.*

This bad practice is, fortunately, but seldom met with, still the author knows of at least two cases in his own practice where the pipes were filled with water between his visits, so that the same would stand the severe test called for by him. The superintendent can easily find out whether the pipes have been so treated by requiring some caps to be removed from drop lights, when water will usually run down. It is safest to condemn the entire piping where such a discovery is made, for sooner or later such a gas pipe system is bound to give trouble from rusting of the pipes, particularly at the foot of vertical risers or branches.

25. *No gas pipes to run through heat or smoke flues; no gas pipes to be put under tiled or other hearthstones where this can be avoided.*

The branch piping for gas logs in fireplaces forms an exception to this rule. Otherwise it is better to run the gas pipes between floors in such places where they remain accessible. Leaky gas pipes in flues have, in rare cases, caused fires, and for this reason it is better to avoid flues.

26. *Gas outlets to be placed in the proper position as marked on the lighting plans. Outlets should never be located behind doors or too near to the heating apparatus, to window curtains or the wood trim.*

It should be the superintendent's duty to observe whether all gas outlets are properly placed. Where in the plans the outlets are put behind doors, the superintendent should at once change the location of such lights and so instruct the fitter. The other precautions are self-evident.

27. *Ceiling outlets for gas to be properly centered to the ceiling of the room.*

This rule appears to be so simple as hardly to require any word of explanation, yet there are many cases where it is rather puzzling to determine the proper center of a room or ceiling. It is the duty of the superintendent to assist the gas fitter in the finding of the proper center. In the case of pantries, for instance, with cupboards running to the ceiling the center should be determined between the front line of the cupboards and the opposite wall line, and not from wall to wall.

28. *All sidelights to be placed at a proper height above the floor.*

Unless the specifications call for a specific height, the superintendent will have to determine what the proper height should be. He should remember that where combination fixtures are used, it is well to place the outlets higher than ordinarily required. From 5 feet to 5 feet 6 inches used to be the proper height, but nowadays it is better to place outlets higher, say from 6 feet to 6 feet 6 inches. The superintendent should determine by careful measurement whether all the side lights of one room have been placed at exactly the same height from the finished floor level.

29. *All distributing gas lines and all branches to outlets to be of proper and sufficient size.*

In some cities, gas companies have a set of rules and tables by which the proper size of gas pipe may be determined. In New York City such rules were enforced years ago, but subsequently, with the greater competition existing between various companies, the rules fell into oblivion, and each gas fitter was a rule to himself. At the present date gas piping is again controlled not only by rules of the Building Department, but also by rules of gas companies. Unless guided by the superintendent, a gas fitter will usually use a larger amount of small size pipe than would be allowed by any of the rules.

It is desirable to put in the specification a table governing the sizes to be adopted, the length allowed for each size for a certain number of lights, etc. It is particularly necessary to see to it that large pipes are used for the risers, and the main horizontal runs, also for the lines supplying gas logs, and the outlets for cooking. The superintendent should bear in mind that air or machine gas requires larger pipes than ordinary city gas. In the best practice no pipe smaller than $\frac{1}{2}$ inch is used even for the branches to a single outlet. Much subsequent trouble due to a deficient gas supply is thereby avoided.

30. *The gas meter or meters to be put in a proper place in the basement or cellar.*

While the gas meter is furnished and put in place by the company, it is yet necessary that the fitter should know, at least approximately, where the meter is intended to be set. As a rule, the house plans do not show where the gas meter is to go, and it is part of the superintendent's duties to select a good place. In doing so, he should remember

that a gas meter requires to be set in a moderately cool place, free from the danger of freezing, but well lighted and easily accessible.

31. *The distribution pipes for gas to be arranged in a proper manner.*

By this is meant that the gas fitter should not run the pipes in a hap-hazard manner, as is so often the case, but that he should follow some system in the arrangement of the gas distributing pipes. In my judgment, the proper system is one in which, similar to the water pipe distribution system in a building, the main distribution is effected at the cellar ceiling. This means, of course, a larger number of gas risers, but it also implies shortened horizontal runs.

32. *The gas log valves for fire places to be put in proper position in reference to the mantels or the cabinet work.*

This is a matter to which the superintendent should give his close attention. Usually, the pipes supplying gas logs are put in to within a few feet of the fireplace, and are finished up when the mantels have been selected or furnished and set.

33. *Gas logs, gas cooking ranges, gas water heaters, and gas outlets for laundry irons should not be supplied from the lighting lines, but from separate gas risers and distributing lines.*

The superintendent should call the fitter's attention from the very beginning to this requirement, which now-a-days is found in all good gas piping specifications. Such arrangement secures a much better supply of gas, both at the fixtures for light, and at the places where gaseous fuel is used in a household. It is even desirable that a separate gas

meter be provided for the line furnishing gaseous fuel. In the majority of cities gas companies are perfectly willing to furnish two gas meters for a house.

34. *All gas piping to be thoroughly tested, by mercury gauge and air force pump.*

It is the superintendent's duty to enforce a proper test of the entire gas piping when completed, and to witness and record the results of such tests. This test should be made before plastering is begun and it should be repeated just before the gas fixtures are hung.

35. *The gas piping to be entirely completed before the plastering is begun.*

The superintendent should see to it that the gas piping is begun at an early stage of the building, and that the gas fitter works with a sufficient force of men to complete the same before the plasterers begin. This will save much trouble in cutting up the plastering to put in lights omitted or added.

36. *Check off all gas outlets according to the lighting or floor plans.*

The superintendent should carefully go over the completed gas piping before the test is applied, and check off the number of lights and outlets, also see that all are placed in their correct position.

37. *All nipples and drops must be plumb and at right angles to the surface from which they project and they should be of the proper length for attaching the gas fixtures.*

This is of much importance, and the superintendent should keep a watchful eye upon all outlets and see that the nipples are neither too short nor too long and conform in every way to the requirements.

38. *All gas risers for light to be connected at the top floor for a better circulation of the gas.*

It is not often that this requirement is followed, but more recently attention has been called to the importance of a proper gas circulation in the risers. If this method is adopted, the frequent undue variation in the gas pressure on different floors of a house is avoided, better results are secured in lighting up, and, in some cases, accidents from the flame becoming extinguished on account of lack of pressure and from the escape of gas which follows are prevented.

NOTE. See also the author's book "Gas Lighting and Gas Fitting," Van Nostrand Science Series, No. 111. Price 50c.

III.

ROUGH WORK; SOIL, WASTE, VENT AND LEADER SYSTEM AND DRAINS.

When the sewer, water and gas connections are made, and soon after the gas piping is commenced, it becomes necessary for the plumber to begin the construction of the soilpipe system. This is usually designated by the trade as the "rough work." It comprises the layout of all drain pipes in the cellar, with their branches for the vertical lines of soil, waste and leader pipes. It also embraces all stacks of soil, waste and vent pipes, likewise the branches for outside leaders, the stacks of inside leaders, and the branches to area, court, yard, and cellar drains, etc.

The roughing for the fixtures comes somewhat later, and will be considered under a separate heading.

39. *The drain pipes in the cellar to be properly run, both as to alignment and fall; they should be of sizes as noted on plans or called for in specifications.*

A good layout of the cellar drains is the basis or foundation upon which to build up a good soilpipe system. After some experience, a superintendent will readily distinguish between a workmanlike and a "botched" job. Regarding the fall for pipes, the rule-of-thumb requirement of the Building Department that "pipes should have a minimum fall of $\frac{1}{4}$ inch to the foot has done more harm, perhaps, than good. For how often do we find, where the opportunity is afforded of giving pipes a good fall, that the workman

adheres blindly to this rule. The superintendent should call his attention to the fact that in order to be self-cleansing, small pipes require more fall than larger pipes. Consult the tables and diagrams of velocities and discharges in house drains.

40. *Proper and sufficient clean-outs to be provided where shown on the plans; those located underground to be provided with brick pits and iron covers.*

How handy and convenient plenty of clean-outs on drains are, those only know who have to do with the inspection and cleaning or repairing of drainage systems after they have been in use for some time. Let the superintendent watch carefully to see that clean-outs are not omitted. All clean-outs should be placed in easily accessible positions. Wherever required, cast iron frames and covers should be provided for them by the plumber or the builder.

41. *The use of T-connections instead of Y-branches in house drains or horizontal branches generally, should not be permitted.*

To join two branches of a drain at right angles is a very bad practice. The so-called T-Y branch, which is really a Tee with a short curved connection into the main may be used at the discretion of the superintendent. He should remember that while it is very handy and excellent on vertical soil pipe lines, it should not be used on horizontal branches, except in special cases where room is lacking to put in a full Y-branch.

42. *The main drain trap and the area and leader traps should be kept accessible.*

This is quite important, for the trap is the place where stoppages are likely to occur. Traps should therefore be

made and kept fully accessible. The superintendent should not permit the burying of traps in concrete.

43. *Chases for soil pipes to be built or left by the mason in their proper places. The Building Department rules do not permit chases to be made deeper than* 4 *inches, and no chases at all shall be left in walls* 12 *inches or less in thickness.*

Even when marked on the mason's plans, chases are sometimes forgotten, or not put in the right place. Desirable though it is to keep soil and waste pipes out of chases, there are, nevertheless, situations where the pipes must be placed out of sight. The superintendent should see to it that the proper chases are provided.

44. *The framing of the floor beams to be so arranged as to allow for branches from the soil pipes to the water-closets without cutting the beams.*

This is exceedingly important, and should never be overlooked by the superintendent. It will save a good deal of annoyance or extra expense. It is just as easy to frame at the proper time for water-closet branches as it is to frame for fireplaces, yet while the latter are always properly cared for, the framing for the plumbing fixtures is frequently neglected. A good superintendent will look ahead and provide for these matters.

45. *Steps in bathrooms and in toilet rooms to be avoided.*

A step at the bathroom door is exceedingly awkward. A good superintendent will usually overcome difficulties arising in the arrangement of the branches for a group of plumbing fixtures in such a way that steps will not be required. He can do this, either by an early attention to the framing of the beams (see No. 44) or by suspending the pipes at the ceiling below, either in regular hanging ceilings, or by

furring them down a few inches, or, finally, by keeping such pipes exposed below the ceiling.

46. *Windows, against which sinks, laundry tubs or washbasins are placed, must have the sill sufficiently raised to allow for a back of proper height for the fixtures.*

This is another matter frequently overlooked in drawing the plans and elevations. Hence, the superintendent should carefully examine the plans at an early stage of the work, and where he finds sills that are too low for fixtures to stand against, he should order them raised to the proper height. For sinks the sill should be at least 4 feet 6 inches from the floor to allow for a proper back.

47. *See that the fresh air inlet is so arranged that it will at all times remain free and unobstructed.*

The location of the fresh air inlet in the sidewalk near the curb, protected by a grating, is not a desirable one, and few are the inlets which do not become stopped up partially or completely after some years. Where the front area is wide, my decided preference is for a standing pipe located in the extreme outer corner of the area, and protected with a quarter bend and bronze or brass strainer. Let the superintendent beware of new-fangled patent devices, even when claimed to be approved by Building Departments. In some cases, where the fresh air pipe cannot be given a sufficient pitch to remain free and clear, special flushing arrangements may be provided. Some of these are intended to act automatically. I fear that the Water Departments would object to them as being wasteful of water. Besides, a regular flushing is hardly required here; an occasional good flush, turned on by hand, is all that can be reasonably required.

48. *Soil and vent pipes should not be run into flues; leaders should never be used as soil pipes, nor should soil pipes be used to carry rain water.*

These are among the fundamental rules on house drainage. The why and the wherefore may be found in any elementary book on house drainage.*

49. *See that all joints in cast iron soil pipes are run "full with lead;" see that the plumber does not "cant" the joints to save a few fittings; that old lead pipe is not melted up to be used for calking the joints.*

The above are all details regarding the work of the plumber, which it behooves a superintendent to watch over to the best of his ability. They require on his part a good deal of practical knowledge and experience in the plumber's craft, which only years of familiarity with such work can give.

50. *All soil, waste and vent pipes to be properly supported and fastened.*

All such pipes must be well and firmly supported, and the use of ordinary soil pipe hooks should not be permitted; there are several better methods available for doing this.

51. *No vent pipes to be run at angles of less than* 45 *degrees to the horizontal.*

This is of great importance in the case of cast iron pipes. Years ago such pipes were coated with asphalt or coal tar varnish, and there was not much rusting of the inside of pipes. Now the cast iron pipes are required by plumbing regulations to remain uncoated, and a good deal of rust

* See "House Drainage and Sanitary Plumbing," 11th edition, by Wm. Paul Gerhard, C. E. Also "Recent Practice in the Sanitary Drainage of Buildings," by the same author, 2d edition.

accumulates at the foot of all offsets and bends. Hence the above requirement, which seeks to have pipes run at such an angle or inclination that whatever rust forms will not lodge, but will slide off the steep pipe and be washed off with the waste water or the flush from fixtures. In the case of galvanized wrought iron pipes the rule is likewise important, particularly in view of the unsatisfactory way in which much of the galvanizing is done nowadays. It is always desirable that vent pipes be washed at the foot of the stack by the nearest available fixture.

52. *The Tees for the vent line branches from fixtures must be set sufficiently high above the overflow point of these so that the vent cannot become a waste in case of stoppage of the latter.*

Experience has shown that where this requirement is not followed, a stoppage of the waste may occur which will not only go on for a long time unnoticed, but which will ultimately cause the vent to become choked, with grease or otherwise, particularly so in the case of kitchen and pantry sinks.

53. *All balconies, small roofs, areas, courts, yards and light wells must be drained and the branches trapped.*

This is very important, especially so where windows open up on balconies or on extension roofs. In some of the modern houses all such wastes are disconnected from the soil or house drain system and run in the same way as safe waste or refrigerator wastes.

54. *All main leader pipes must be trapped.*

This is necessary for obvious reasons, except where the leader terminates on a main roof, away from windows, or ventilating shafts. The superintendent should see to it that the leaders are safely trapped.

55. *All roof joints to be made perfectly water tight.*

The places where plumbers' pipes pass out through the roof require special attention, and must be tightened just as well as the roof itself. Proper lead or copper flashings should be used for this purpose.

56. *Vent pipes on roofs to be kept away from water tanks, flues, vent shafts or dormer windows; on pitched roofs vent pipes should not be run so as to be exposed on the front of a building.*

The reasons for this requirement are so obvious as not to demand further explanation.

57. *Where soil or vent pipes are run in partitions, the hubs shall be so set as not to protrude beyond the plastering.*

It is difficult, especially in the case of cast iron pipes having hubs at every 5 feet or oftener, to hide the hubs in the partitions. For larger pipes it becomes necessary to increase the thickness of the partition to accomplish this, and the superintendent should keep an eye on all such pipes to avoid the unsightly appearance of hubs.

58. *Where the screw-jointed wrought iron pipe system is specified, the superintendent should keep close watch over the fittings used, to see that the special "recessed" or drainage, and not the common steam, fittings are used.*

There is quite a difference between the two kinds of fittings mentioned.* Unscrupulous contractors may purchase and use the cheaper steam fittings, which do not give a smooth interior water way, and are unsuitable for purposes of drainage. In the best work the recessed fittings are also used for the vent pipe system. Drainage fittings

* See the illustrations in the author's book "Sanitary Engineering of Buildings."

are either of cast iron or of malleable iron, the latter cost a good deal more but are preferable for high buildings. The superintendent should see to it that where malleable fittings are specified, the contractor does not substitute cast iron fittings for them.

59. *Pipe openings in floors and ceilings to be closed up with fire stops.*

This is a good requirement of the Building Law. Leaving aside, however, the question of safety from fire, the closing up with mortar or plaster of all floor or ceiling openings accomplishes a very important object, namely, it stops local odors from traveling from one floor to another. It also helps to exclude vermin, and tends to prevent sounds from traveling to adjoining rooms. This work is often left undone, unless the superintendent insists upon it.

60. *See to it that in the arrangement of the vent pipes for a group of adjoining fixtures there is no bye-pass.*

Bye-passes in the drainage or vent pipe system are dangerous, as they permit sewer air to enter through the fixtures, though these may be to all appearances well trapped. The superintendent should examine carefully the lay out of the vent lines for the fixtures with this in view.

61. *Vent pipes from sewage sumps or sewage ejector systems should not be interconnected with vent pipes of the house drainage system, which connect directly with the street sewer.*

Modern buildings frequently require drainage arrangements below the level of the street sewer. The low level sewage is made to run into either sewage sumps or into sewage ejectors and is lifted from these to the high level sewer by means of either centrifugal pumps or else by means

of compressed air lifts.* The sumps as well as the ejectors should be ventilated to the roof, and the superintendent should see that no other branches or vents are tapped into the vent line used for this purpose, as this would create an objectional bye-pass.

62. *Where much sub-soil water is encountered in the cellar of deep buildings, this is taken care of by means of sumps emptied with centrifugal or other pumps. Sumps for sub-soil water should be kept separate from those for foul sewage.*

It is desirable for several reasons that sub-soil water and any other undefiled water, such as drips from pumps, etc., waste pipes from filters, etc., should not be connected with or discharged into the sewage ejectors, and the superintendent should examine the drainage plans with this in view, and see that the proper separation of the clean waste water from the foul or sewage waste is carried out.

63. *Always consult the plumbing sections for a building to see that the entire "rough work" is carried out in accordance with the same.*

Deviations from such sections or plans may sometimes become necessary, but the plumber's foreman should always consult with the superintendent before making any changes in the layout. The superintendent should also carefully watch for any interference of the plumbing with heating pipes or ducts, or vice versa.

* The sewage ejectors most commonly employed for such purposes at the present time are the Shone ejector, the Ansonia ejector, the Ellis sewage lift, and the Adams sewage lift.

IV.

WATER PIPES, TANKS, METERS, BOILERS, HOT-WATER TANKS, PUMPS, ETC.

THE putting in of the system of hot and cold supply pipes for a building is usually not started until after the rough work or soil pipe system is in place and tested. Frequently it becomes necessary to run supply pipes in the same chases with the soil pipes or waste pipes and it is, for obvious reasons, better not to put the supply pipes in place until after the workman is sure that his large waste and soil pipes are tight. After the test, it is a common practice to run the vertical lines of supply pipes first, and to leave the horizontal pipe distribution at the cellar and basement ceilings until after these are plastered. Although the water tanks, the boilers, the pumps, hot water heaters, etc., belong properly to the fixtures, they are discussed under this heading as belonging to the supply system.

64. *Make provisions for the plumber to run the vertical lines of supply pipes so they will not show, where this is undesirable, yet be accessible and readily reached, for instance, on the parlor floor.*

It is well for the superintendent to take this matter in consideration in advance, and sometime before the running of the supply lines begins, otherwise he may find, when too late, that no proper and sufficient room has been provided for these important pipe lines.

65. *Put pipe sleeves in walls, partitions, and floors for the supply pipes to pass through before plastering is done.*

A careful workman will bear this point in mind, and arrange for it accordingly. An experienced superintendent will remind the plumbing foreman of this matter, thus avoiding subsequent patching of the plastering.

66. *As soon as soil, waste, and vent pipes are in place, the superintendent should see that the plumbing contractor orders the water tanks, filters, pumps, heaters, in order to deliver these into the building while openings in the floors are available to lower the fixtures into the cellar.*

Much trouble and expense may be avoided by a proper attention on the part of the superintendent, at the right time, to this matter.

67. *Water meters, where required, to be properly located.*

Ordinary houses are not supplied with water through a water meter, though the larger residences, which require taps of unusual sizes, form an exception. In these, as well as in office buildings, hotels, institutions, etc., the water is nearly always metered. The superintendent should be consulted about and should select the place where the water meter is to be located, unless the same is shown on the water supply plan.

68. *Supply pipes should never be run on outside walls, or in chases of outer walls, without adequate protection against freezing.*

One of the greatest annoyances in occupied buildings is the freezing and subsequent bursting of supply lines. A careful workman will always so run his supply lines that the pipes will not freeze, but the superintendent should personally satisfy himself that this important point is not neglected. Where pipes must necessarily run in soil-pipe

chases in outside walls the supply lines should be thoroughly wrapped with a good non-conducting covering. The superintendent should determine what kind of covering to use, and where to apply the same. He should also see that the plumber leaves a sufficient distance between pipes to allow of the covering being put on properly.

69. *The plumber to provide water for building purposes, also for flushing the temporary workingmen's water-closets.*

This is one of the first things required of the plumbing contractor on nearly every job. The superintendent should give the orders for this work, so that the builder may have taps available to attach his rubber hose for wetting the bricks, and for mixing the mortar. Regarding the temporary water-closets for the mechanics on the work, the superintendent should see to it that a good type of fixtures is used. My personal preference is for a plain enameled iron flushing-rim hopper, supplied from a valve operated by a self-raising seat. In the majority of cases the plumber will put up a school sink or other trough fixture. Actual experience shows that these soon become foul and are always in a neglected state. The specification should call for the plumber or the builder to be responsible for the sanitary condition of the closets during the construction of the building.

70. *Supply pipes should not be run horizontally over decorated ceilings.*

It was usual, until a few years ago, to run the supply pipes concealed in the floors, and these runs were often of considerable length. Instead of placing the main distribution system at the basement ceiling, the distribution was effected in the floor above. This being usually a hardwood or parquet floor, the supply pipes became difficult of

access for repairs in case of leaks. The new method of exposing all such pipes at the basement ceiling has considerable merit, and is therefore always preferred now-a-days.

71. *Lead supply pipes to be of proper weight and thickness, also of the proper size or diameter.*

In the majority of buildings now-a-days the supply pipes are either of galvanized wrought iron or else of tinned brass. But there are some jobs where lead pipes are called for, for the supplies. The superintendent should examine the lead pipes carefully before they are used, and ascertain whether they are of proper weight and thickness, and of the sizes called for.

72. *All water pipes must be properly and sufficiently supported and fastened to prevent sagging and pulling loose.*

Careful workmen need not be told that water pipes must be well supported, the vertical pipes, if of lead, at distances of about two or three feet, if of iron or brass, every six or eight feet, and the horizontal pipes continuously in the case of lead pipes. The superintendent must keep a watchful eye to ascertain if this requirement of good workmanship is carried out. The future durability of the entire supply system will depend upon it.

73. *All water pipes must be so run and graded that they may be completely emptied when so desired.*

This is a very important requirement, particularly so for country houses, which are closed up during the winter months. It is almost equally necessary in city buildings, for many houses remain shut up in winter while their owners are away, and houses to let sometimes remain unoccupied. All supply lines should be run with a slight but continuous

fall, and low places or traps in horizontal lines should be avoided; where they cannot be avoided, it is necessary to provide draw or drip cocks, so that the pipes may be entirely emptied when so desired. The superintendent should make sure that this precaution is not overlooked.

74. *Supply pipes should not be bent upwards in their horizontal courses, as this will cause them to become air bound; nor should they be bent down or depressed, as this will cause trouble in winter time from freezing and bursting.*

These requirements form some of the refinements of a proper water distribution system, but a careful workman will observe them as a matter of course. It is only in cases of careless or incompetent workmen that the superintendent finds himself compelled to insist upon the observance of the rule.

75. *All supply pipes (if of wrought iron or of brass) to be carried plumb and equidistant from walls or partitions.*

It will contribute much to the good and workmanlike appearance of a job of supply piping to have these requirements followed.

76. *Proper shutoffs to be used on all supply lines to control them separately.*

It is not sufficient to have a main shutoff where a supply service enters a building, but all main lines and their distributing branches should have shutoffs. In addition to this there should be shutoffs at the foot of all vertical risers.

77. *Shutoffs to be provided at all fixtures and at all flushing cisterns.*

Unless the specifications call for such shutoffs, the plumbing contractor cannot be expected to put them in.

They are, however, a great convenience, for they enable the separate control of each fixture, and this is of particular importance in case of repairs. Where the superintendent finds that the specification does not call for these separate shutoffs, he should call the architect's attention to the matter. If this is properly explained to an owner, he will often willingly order the small extra for the sake of having his work more complete and controllable.

78. *No pipe hooks to be used in the fastening of supply pipes.*

Where lead pipes are used, the vertical runs are to be supported by metal tacks fastened by screws to wooden boards, and horizontal runs must be supported on boards to prevent settlement. Wrought iron and brass pipes are secured and held in place by ring holdfasts or by special pipe hangers. Hooks driven over lead supply pipes are apt to injure these.

79. *Exposed cold water pipes, particularly those of iron, are not to be run in positions where the dripping of water from accumulated condensation will do damage.*

This is a point of much consequence, and one apt to be overlooked by all except the most experienced superintendents. The moisture which condenses on the outside of cold water pipes in drops is apt to run down the pipe in a small stream. It is not always easy to find a remedy for this annoyance. Of course, the pipes may be cased up in non-conducting or anti-sweat covering to prevent condensation, but this increases the cost of the work, and is not particularly sightly at the ceiling of kitchens or laundries. Another remedy consists in placing semi-circular troughs under such pipes as are apt to sweat, and to provide the troughs with some fall and with a drip pipe or waste outlet.

80. *Water pipes should not be run directly over any electric wiring, switch boards, rheostats, electric motors or generators.*

The superintendent should pay particular attention to this requirement which may prevent a good deal of damage to the electrical machinery, caused by water of condensation dripping down over the electrical fixtures named.

81. *All joints on lead water supply pipes should be solder-wiped joints.*

Wiped joints are much stronger than the so-called cup joints, and on all pipes carrying water under pressure only the strongest joint should be used.

82. *Brass supply pipes must have the threads so cut and fitted that they will not show or project when the pipe is screwed home.*

This is one of the refinements in the workmanship, but one which is observed by the best workmen. It makes a vast difference in the looks of a nice job of brass water piping whether the threads show or are completely concealed.

83. *All water pipes must be of proper and sufficient diameter.*

This is one of the points to which the superintendent should pay close attention. If the specification is properly drawn, he should see that the sizes therein called for are carefully followed. Where he discovers a deficiency in a size specified, he should bring the matter to the attention of the architect rather than permit the supply to be put in of insufficient size.

84. *All valves to be properly tagged and numbered.*

A list of the valves on the supply lines of a building will be of inestimable value for future reference. In all first-class work such a list is called for, and the valves are

separately and systematically numbered on tags which are permanently attached to the valve stems. With the aid of such a list the owner is enabled to shut off the various parts of his supply system in cases of repairs or emergencies without being obliged to send for a plumber. The list is of equal value to the mechanic who may be called into a strange building to do some work in connection with the supply system. In some specifications a clause is inserted stating that the final payment will not be made until the list has been handed over to the architect or superintendent.

85. *Where brass pipe is specified to be used for supplies, it should be tinned on the inside and it should always be properly annealed. Where wrought iron pipe is called for for supplies it is necessary to specify "genuine wrought iron pipe," as otherwise the contractor will furnish steel pipe. For the galvanized iron fittings for supply pipes it is best to call for malleable fittings, particularly on the larger sizes of pipe.*

The matters mentioned will require the most careful consideration by the superintendent so that no inferior materials are substituted for those called for.

86. *Proper provision to be made, by means of iron I-beams for the support of the house tank.*

It is always safest to carry the large weight of house tanks on iron beams in preference to wooden ones. In New York City this is a requirement of the Building Department for all house tanks larger than 1000 gallons capacity.

87. *House tanks must have covers and be well ventilated.*

A tank intended to hold water for household purposes should always be kept scrupulously clean and free from dirt or dust. It is advisable to provide a cover, of wood, made preferably in sections, so that a part of it may be

readily lifted for the inspection of the interior of the tank. It is also recommended to make proper arrangements for the ventilation of the water tank.

88. *Drinking-water tanks made of wood should not be lined with lead.*

The plumbing ordinances of many cities require that tanks for household water be constructed either of wood (round stave tanks), or of wood lined with tinned copper, or else of cast or wrought iron. The lining of tanks with lead is objectionable on account of the danger of lead-poisoning. Slate tanks are free from objections, but not much used. The superintendent should see to it that the plumber uses the proper material for lining his house tank where the same is constructed of wood.

89. *Tank overflow pipes should not be connected with any soil or drain pipe or with the house sewer.*

This is an extremely important requirement, which demands special attention on the part of the superintendent. He should see to it that the tank overflow is run in a proper manner, either to the roof or into a roof gutter, or else to a well-trapped and water-supplied sink in the lower part of the house, where an overflow at the tank would at once announce itself.

90. *The storage tank for water should never be placed in the same room with a water-closet. Water-closet tanks should never be made storage tanks for the house supply, nor should they be used to supply kitchen boilers or other fixtures.*

Although the above propositions seem self-evident, yet the writer remembers finding cases, where a water-closet was placed in the same apartment where the house tank stood, thus subjecting the water in the tank to the contaminating influence of the air from the water-closet.

91. *The overflow pipes for house tanks should preferably be standing overflows with a trumpet-shaped or funnel-shaped mouth.*

The overflow pipes described above have a very much larger discharging capacity than the ordinary overflow pipes taken out from the side of a tank, and for this reason the superintendent should require the contractor to install overflow pipes of such shape.

92. *All pumps should be provided with air chambers both on the suction and on the discharge ends of the pump.*

This insures a smoother and more quiet action of the pump. The superintendent should ascertain whether air chambers of proper size and material are used. Further noiselessness of the pump may be secured by using short pieces of rubber hose on the suction and discharge piping.

93. *Where bathtubs are supplied from the bottom, or have a so-called "bell supply" opening near the bottom, the hot and cold supply pipes should be provided with check valves.*

This is a point easily overlooked, and one which is seldom observed by plumbers' supply houses or manufacturers of plumbing apparatus. A bottom supply brings with it some danger of the fouling of the supply pipes and of the water supply in the lower parts of a house, as, for instance, at the pantry sink faucets. When water is drawn for drinking purposes at this sink, the contents of a bathtub on an upper floor may be siphoned out, if the bell supply to the tub happens to be opened at the time water is drawn below. The superintendent should therefore insist upon the placing of proper check valves in the supplies to the bath tub.

94. *Hot and cold water pipes must not touch each other. They should be suitably separated wherever exposed, and where inclosed in places like partitions, boxes, floor troughs, so that the hot-water pipe will not heat up the cold-water pipe.*

Nothing is more annoying to the owner of a newly completed house than to find, upon opening the cold-water faucet at a basin, that he is drawing hot water. This is often caused by the hot and cold pipes touching each other, generally in confined places or where such pipes cross each other.

The superintendent should carefully examine the course of all hot, cold, and circulation pipes to make sure against this defect, which is not always easy to remedy, particularly in the case of iron or brass supply pipes, after the work is completed. Pipes in confined places should be covered with non-conducting covering, at least the hot-water and circulation pipes. Cold-water pipes should also for obvious reasons be kept away from steam pipes.

95. *Hot-water and circulation pipes must be properly graded to insure a good circulation of the hot water from the boiler or the hot-water tank.*

The superintendent should give attention to the manner in which the plumber runs the hot and circulation pipes. Both lines should have a continuous though slight ascent or grade. It is particularly important, in order to obtain good results, that these pipes should not be trapped anywhere in their course.

96. *Hot-water pipes should have an expansion or steam escape pipe carried up over the house tank. In direct street pressure systems a safety and vacuum valve should be provided at the hot-water tank or boiler, with a drip pipe carried over a sink.*

Where a steam escape pipe is carried up over the house tank, the superintendent should see to it that the same is carried up *sufficiently high* over the tank to prevent the siphoning over of the hot-water into the house tank.

Where a safety and vacuum valve is used, the superintendent should examine the working of the same, as none but the very best will answer the purpose.

97. *Check valves should always be of the swinging pattern and should be placed horizontally.*

Although check valves of any kind are for several reasons undesirable adjuncts to a supply system, there are, nevertheless, cases where it is necessary to insert them, and in order to be on the safe side it is always advisable to insist upon the best pattern of check valve being used.

98. *Make sure that all proper bye-passes or cross-connections are installed, and that all fixtures are supplied as called for from either tank or street pressure, or sometimes from both; also that no branches are taken from the pump riser, etc.*

It is of importance that the superintendent should carefully watch over the plumber to see that the requirements mentioned are carried out. It is undesirable to take supply branches from the pump riser, for the reason that when the pump is going its pulsations may be observed at the faucets when the latter are open.

99. *The size of the kitchen boiler to be in proper proportion to the water-back in the range, and vice versa.*

Where hot water is supplied to a house from a boiler in the kitchen, the superintendent should make sure that the water-back in the range is sufficiently large to heat the water in the boiler. He should also, however, make sure that a boiler of sufficient capacity is used to store the

water heated by the size of the water-back in the range.

100. *Make sure that the hot-water connections between water-back in range and the boiler are not trapped; also guard against other wrong or defective connections at this point. See that proper allowance is made on hot-water lines everywhere for expansion.*

The observance of these precautions will help much in securing to a building a properly working hot-water system. It should be the duty of the superintendent to look after these points.

101. *Hot-water tanks in which the water is heated by means of steam and inside coils must be located sufficiently high above the water line in the steam boiler so as to permit of a proper circulation of the steam if a gravity return circulation system is used.*

This matter should be looked into by the superintendent in connection with the steam-heating as well as the plumbing. The plumber, too, may save himself quite often unnecessary expense and trouble by conferring with the steam-heating contractor about it before running his pipes. It is also clear that the layout and run of the entire hot-water pipe system will depend upon the question whether the hot-water tank may be placed on the cellar floor, or, as is more often the case with low-pressure steam-heating apparatus, has to be suspended from the cellar ceiling in order to permit the steam to circulate properly.

102. *Hot-water tanks which have inside tubes or coils for the circulation of steam, and likewise horizontal feed-water heaters, should be so placed that the tubes may be drawn out for repairs.*

The superintendent should examine the proposed location for the hot-water tank or feed-water heater as shown on the water-supply plans, and should ascertain whether there is sufficient room to accomplish the object described in this paragraph.

103. *As soon as the water connection has been made for a building, the superintendent should require the plumber to ascertain by means of a pressure gauge the existing water pressure in the street main.*

The knowledge of this pressure is required in order to determine the supply system for a building, *i.e.*, to fix the number of floors which can be reached from street pressure and those that must be supplied from either a roof tank or a pressure tank. In many cases it is necessary that the records of the pressure gauge should be taken for a period of twenty-four hours, as the street pressure in the main may vary considerably during day and night hours.

104. *In the water-supply layout proper and sufficient place should be provided for the entire water-supply plant, and in particular for the suction tank, the pumps, the meters, the filters, the gauge board, etc.*

It is very objectionable to have the water-supply plant in the sub-basement of a building crowded together into an insufficient space. This defect can be avoided by sufficient attention at the proper time to the floor spaces occupied by the appliances specified. The superintendent should study the water-supply plans closely and ascertain from the pump, filter and other catalogues that sufficient space has been actually provided.

105. *Where the plans and specifications of a building provide for the installation of fire protection or fire extinguishing appliances, the superintendent should endeavor to have*

the same installed at an early day during the construction of the building.

This requirement is of importance, because, while the interior construction and equipment of a building are going on, fires are liable to be built or furnaces used, and, inasmuch as carelessness is apt to prevail, outbreaks of fire in buildings in course of construction are not rare.

Where an inside fire standpipe is called for, it is well to have the same placed in position with all necessary outlets and fire valves, and furthermore to provide the pump or tank which supplies the line. In buildings where outside fire-department connections are called for or required by law, it is advisable to provide at least the outside connections, the fire standpipes and the fire valves. Should a fire occur it would be a great help to the fire department to be able to connect the engines to the outside connections and to run lines of hose on the floors which are endangered by the flames. Where fire casks, buckets and pails are to be installed, it is a good plan for the superintendent to see that these are not only furnished long before the building is completed, but that they are actually put to use and kept in readiness as protection.

V.

ROUGHING FOR THE PLUMBING FIXTURES.

When the soil-pipe system is completed and the supply system run, it becomes necessary to "rough" for the fixtures. Under this term is understood the running of all the waste, vent and supply branches required for the setting and connecting up of the various plumbing appliances. This roughing must be quite completed before the walls and floors in bathrooms and in kitchen, laundry and pantry can be finished with either wooden wainscoting or else tile or marble, as the case may be.

It is quite important that all the fixtures should be roughed for before the soil and vent pipe system is tested by being filled with water to the main roof. This does not, of course, prevent the plumber from making a preliminary test to examine the tightness of his main stacks without the branches. In former times, it was not usual to test the branches for the fixtures, but since attention was drawn to the importance of including in the water-pressure test all ferrule joints, the lead bends for closets and slop-sinks, and the branch vents for tubs and basins, etc., a good plumber will complete the roughing before making the hydrostatic test. In New York and in some other cities this is now required by law.

106. *Provide plenty of space for the plumbing fixtures shown on the plans. Make sure to get the correct roughing measurements for all the fixtures specified.*

It is a good plan for the superintendent to ascertain at an early date if the fixtures shown on the plumbing plans can be actually accommodated in the available dimensions of the space reserved for the fixtures. Quite often it happens that the draughtsman in the architect's office draws a fixture, such as a bathtub, of smaller dimensions than it actually occupies, and unless this is detected in time, there is apt to be considerable trouble when the attempt is made to space the fixtures of a bathroom, or a set of laundry tubs, for instance, correctly. With the multitude of fixtures at present available in the market, it is not easy for a plumbing foreman to remember accurately all roughing measurements for water-closets, sinks, tubs, basins, etc. He should therefore make it a rule, on every building, to obtain from the manufacturers accurate cuts or blue prints with clearly shown dimensions to enable him to lay out his work correctly. At this stage of the work it will be well for the superintendent to make sure in a general way that the plumber is considering the correct type and make of the fixtures as specified (see also paragraph 124).

107. *Check all roughing measurements for fixtures before the tiling of the floors or walls is begun.*

While this follows from the preceding paragraph as one of the duties of a careful plumbing foreman, it will be well for the superintendent to check the entire layout in his own way, and then to compare notes with the plumber. Quite often it will happen that a slight error detected in time, will avoid the tearing up of the floor tiling or the taking down and resetting of marble wall slabs or tiling.

108. *The roughing for a urinal fixture must be so calculated that the top of the urinal bowl will not set too high above the floor.*

Urinal fixtures are, as a rule, set much too high. The plumber should ascertain first whether the urinals are intended for men, or for boys only. In the latter case the fixtures should be set quite low to be of use. But even in the case of urinals for adults, I would advise setting up the bowl so that its top will not be higher than 21 inches from the finished floor level. Thus arranged, the fixture can be used equally well by tall as well as short men. Experience has clearly shown that the floor slab under this fixture remains much freer from drippings with the urinal set low than when set the usual height of from 24 to 26 inches.

109. *All roughing for fixtures must be completed and checked before tiling of floors is begun, in order to avoid the cutting up of tiled floors.*

It belongs to the superintendent to watch the progress of the plumber and to see to it that he does not delay the tiler in this respect. The same is, of course, true where any other finish than tiling is adopted.

110. *Look for bye-passes in the roughing for the fixtures before the same is covered up by either plastering or wainscoting.*

This has already been referred to in a former section, and it is repeated here merely to impress a young superintendent with the danger arising from such bye-passes or faultily arranged vent pipes for the traps at the fixtures. An experienced superintendent will soon discover any bye-passes by carefully going over the roughing-in work for the fixtures.

111. *See that vent pipes are not so run as to form a trap.*

It is important that all vent pipes shall be so graded

that no water of condensation will lodge or stay in them. For this would, obviously, render them absolutely useless.

112. *Waste and vent connections at fixtures must be made with screw joints.*

This refers only to exposed plumbing of brass; it does not apply to the simpler work constructed entirely in lead. Formerly it was usual to use coupling joints with washers, which did not remain tight for any length of time, or else to use so-called slip joints. In New York City all such inferior joints are prohibited by the plumbing rules.

113. *Water-closets must not have vent horns for the back-airing.*

Until a few years ago earthen water-closets were manufactured with earthen vent horns, and the vent pipe was attached to the horns with brass couplings. It was found by experience that very often the vent horns broke off, or cracked, leaving a dangerous joint on the sewer side of the water-closet trap where sewer air could escape. In testing buildings with the smoke test, this is one of the places at which numerous leaks or escapes are apt to be found. The rule is now to vent closet traps from the four-inch lead bend under the floor. In New York City this is a requirement of the rules governing plumbing. It is not often that the same is violated, but the superintendent of houses built in the country or in smaller towns should carefully bear this point in mind, for it is here where we often find the stock of old-fashioned water-closets used by plumbers, who are either ignorant of the rule and its intention, or who are willfully negligent in the matter.

114. *Traps should not be set too far from the fixture which they are intended to protect.*

Wherever possible, a trap should not be set farther than two feet from its fixture, so as to reduce the exposed length of waste pipe on the house side of the trap to a minimum. In exceptional cases, a trap may be set farther away, but the plumber should consult with the superintendent about this.

115. *Traps should not be too large; they should never be set out of level or be tipped up.*

Usually, the size of the trap to be used under fixtures is described in the specification. Where this is not the case, the superintendent should remember that small traps keep cleaner than large ones. If it were practicable to do so, I should prefer using a trap one size smaller than the waste pipe, as the flush is thereby concentrated. I fully believe that a $1\frac{1}{2}$-inch trap attached to a 2-inch sink waste pipe keeps longer free and clean than a 2-inch trap. In the same way, a 3 or $3\frac{1}{2}$ inch trap is better than 4-inch traps for water-closets. If one would take the trouble to examine critically the interior of a water-closet trap (molded as they now usually are in one piece with the bowl), one would find the trap of modern siphon closets to be but 3 inches in diameter; indeed, the author has seen water-closets with a trap only $2\frac{1}{2}$ inches in size.

The tipping of traps must be avoided for obvious reasons; all traps should be set perfectly level to maintain the full depth of their water seal. The superintendent should carefully examine all traps with this in view, and particularly those set between floor beams, as, for instance, the traps of bathtubs.

116. *Lead waste, vent and supply pipes used at the fixtures to be of proper weight and thickness. The same applies to the lead traps, particularly those under bath*

tubs, and to the lead bends for water-closets and slop-sinks.

Unless carefully watched by the superintendent, a plumber is very apt to skimp his work in this respect. Long practice will enable a superintendent to judge the weight from the appearance of a trap or lead bend. Until he acquires such experience, it will be advisable for him to carefully measure the thickness of the lead intended to be used.

117. *Lead pipe joints on waste pipes should intersect at an obtuse angle corresponding to the Y-branch used in iron piping.*

This rule calls for a workmanlike job seldom to be seen in American plumbing, though in England it is the rule to so arrange the intersections of lead waste pipes. Here it is usual to join lead pipes at an angle of 90 degrees, but it must be conceded that the arrangement called for by the rule is much superior.

118. *See that safe wastes do not connect with soil or waste pipes nor with the drain in the cellar.*

It is a cardinal rule that all safe wastes, likewise the waste pipes from refrigerators and ice boxes, should be disconnected from the soil and drain pipe system. Such pipes should be treated in the same way as the overflow pipe from drinking-water or house tanks. They must discharge openly over a well-trapped water-supplied sink. The superintendent should carefully ascertain whether this arrangement is followed.

119. *There should be no traps at the foot of vertical soil or waste pipes.*

The superintendent should bear in mind that there must be a free and unobstructed circulation through the entire soil and waste pipe system from the fresh-air inlet through

all the house pipes up to the mouth of the pipes on the roof. Where traps are placed at the foot of vertical stacks of soil or waste pipes, they completely cut off the circulation which is necessary to keep the entire system free from foul gases. The only vertical lines, at the foot of which traps may be set, are the rain-water pipes, or leaders.

VI.

SETTING THE PLUMBING FIXTURES.

When the rough work of plumbing a building is completed, there is usually a more or less long intermission, during which the floors and walls of bath and toilet rooms, kitchens, pantries and laundries are completed. During this intermission in his work, the plumber should prepare for the setting of the plumbing fixtures. He should order all the fixtures from the manufacturers and have them delivered at the building. He should likewise order all the brass piping, the traps and appurtenances, and make sure about the right finish (whether polished brass, polished steam metal, nickel plated or silver plated, white metal or electro-bronze finish), according to the requirements of the specifications or the directions of the architect or owner.

While the plumbing fixtures are delivered at the building, the superintendent should examine each of these carefully as to type, make, material, general appearance and defects. Fixtures not in accordance with the specifications should be at once condemned and rejected.

120. *All water-closets to be set with brass floor flanges.*

The importance of an absolutely tight floor connection between the water-closet bowl and the soil-pipe branch or the lead bend is universally conceded. No closet having its trap in one piece with the bowl, and therefore above the floor, should be set without brass floor plate. The superintendent should examine with care all such floor connections

and not permit the use of any siphon or washdown closet without such brass floor plate.

121. *Vitreous ware closets are better than those of ordinary earthenware.*

One defect to which all common earthenware is liable, is the crazing of the surface. The new vitreous ware, now furnished by many potteries, is nearly, if not quite, free from this objection, and should be specified by preference. When the earthen fixtures are unpacked the superintendent should inspect them critically with this in view.

122. *All plumbing marble to be free from defects, to be properly molded, countersunk where so specified, and of the thickness and size specified.*

Nothing is so apt to spoil the appearance of an otherwise good job of plumbing as a poor quality and finish of the plumbing marble. When the specification is strictly drawn, the superintendent should enforce the same in all particulars and reject at once all marble which does not fulfill the requirements.

123. *In connecting marble with brass fittings (such as floor connections, urinal connections, etc.), as little oil as possible must be used to avoid subsequent oil stains in the marble.*

Careless plumbers often ruin a handsome marble slab by the oil or white lead used in the pipe connections. The superintendent should guard against this in time, and warn the plumber, who by the use of shellac may prevent the oil from spreading on to the marble.

124. *Examine all fixtures with a view of ascertaining if they are of the make and style specified.*

This requires a good deal of knowledge and experience on the part of the superintendent. Very good imitations

of fittings or fixtures are sometimes palmed off on an inexperienced man as the genuine article. The owner of the building has the right to expect that those fixtures which he has selected and for which he pays the price in his contract, are used and no others. (See also paragraph 142.)

125. *Provision should be made for a kitchen hearthstone of sufficient size for the kitchen range specified.*

It belongs to the superintendent to find out the size and dimensions of the range selected or specified, and then to determine the proper dimensions of the hearthstone. Frequently the latter is sent to the building of insufficient width. Note that there should be at least 18 inches of stone in front of a kitchen range for the hot ashes which would otherwise fall on to the wooden kitchen floor.

126. *All brass traps to have screw connections.*

The brass traps for sinks, basins and tubs should be examined by the superintendent to find out whether they are provided with screw connections. Neither slip joints nor coupling joints with washers should be permitted; even the ground joint couplings, which are somewhat more secure, are not permitted in the New York plumbing regulations.

127. *Examine the ball-cock supplies of water-closet and slopsink cisterns as to whether they are top or bottom supplies.*

Although the bottom supplies to cisterns give a fixture a well-finished appearance, the top supplies are really preferable. If the superintendent finds bottom supplies at the cisterns, he should insist upon the use of check valves on the cold-water supply pipe to the cistern, as there is otherwise danger of the contents of the cisterns being

siphoned out when a faucet on a lower floor is opened. This is particularly liable to happen where the water pressure is poor.

128. *Traps with cleanout screws must have these arranged either under the water line in the trap or on the house side of the same.*

No other traps than those mentioned should be permitted by the superintendent. Where a cleanout is located on the sewer side of a trap, the joint may leak sewer air in case the cleanout has been removed for cleaning purposes and has not been replaced in a secure manner.

129. *In the case of traps located between floor joists, it is better to omit the bottom trap screws, as they are liable to leak and are difficult to get at.*

This refers particularly to bathtub traps which nearly always are set below the floor. As a rule, the trap can be reached from the waste fitting; in other cases a special cleanout may be arranged and brought up level with the finished floor and closed by a brass trap screw.

130. *All trap screws which depend upon washers for tightness of the joint, are bad.*

It is far preferable to use traps in which the brass plug is screwed into the trap "metal to metal." A washer joint is apt to leak and loose the water seal of the trap. This is particularly bad in the case of concealed traps.

131. *No brass traps having interior dividing partitions should be permitted.*

In New York City the plumbing rules very properly prohibit the use of such unsafe traps. They are, however, manufactured in large numbers, and where the building is located in the country or in a smaller town, the superintendent is very apt to find that the plumber intends to make

use of such traps. He should firmly inform him that such traps cannot be accepted.

132. *All plumbing fixtures to be separately and properly trapped.*

This is one of the fundamental rules in plumbing. There are, however, some exceptions made even in those cities where the plumbing is governed by rules. A set of laundry tubs, for instance, may be trapped by a single trap. A kitchen sink and an adjoining set of one or two washtubs in an apartment house may also be trapped by only one trap. In country jobs one often finds that a whole series of washbasins are trapped by one trap. The same is true of a group of urinals. All such arrangements are defective. It is best to adhere strictly to the above rule, requiring a separate trap for each and every fixture. In the case of washbasins this appears to me to be imperative. I also prefer such arrangement in the case of washtubs, for it gives a quicker and independent discharge to each tub, and the water is not apt to flow back into the adjoining tub to trouble the laundress.

133. *All sinks to have proper strainers.*

The superintendent should examine all sinks to see if they have well-fastened strainers, to guard against obstructions. Iron sinks should always have brass strainers, as cast iron ones are too easily broken. The only exception to the above rule is in the case of special forms of hospital sinks, adapted for the discharge of bedpans. These are usually left without strainers.

134. *All fixtures above the basement floor should be provided with overflow pipes of ample size.*

Water-closets as well as the larger slopsinks form the only exception to this rule. The overflow pipes are particularly

required where washtubs are arranged on the upper floors of a building (as in apartment houses).

135. *Enameled iron sinks and bathtubs should be examined by the superintendent with special care to guard against imperfections, such as scratches, pieces chipped off, etc.*

In the examination of the fixtures delivered at the building, the superintendent should bear this point specially in mind.

136. *Where a number of fixtures are set in a row, as in a large toilet room, see to it that they are set exactly equidistant.*

Nothing detracts so much from the appearance of a well-finished toilet room as to find that the water-closets are not set on center and equally spaced. This is a matter which the superintendent can regulate by proper attention to the roughing measurements of the lead bends for the closets. When the closets are being set by the plumber he should check the distances from center to center of the bowls. When the carpenter or cabinet worker or the marble man, as the case may be, comes to set the compartment partitions, the superintendent should be on hand to make sure that the partitions are correctly set. Sometimes it happens that a floor beam will compel the plumber to set a closet out of center, and in such case the partitions of two adjoining compartments may be set slightly out of center in order to adjust the position of the closets in the spaces.

137. *All fixtures to be provided with separate shutoffs on the hot and cold supplies.*

This is not done except in the very best work. Where specifications provide for it, there is some temptation for the workman to omit some shutoffs which he considers unnecessary. It belongs to the superintendent's duties to see that

all shutoffs called for are put in. At some time or other, every shutoff provided in a plumbing system will come in useful.

138. *All fixtures to have air chambers on the hot and cold supplies.*

Like the separate shutoffs, air chambers are apt to be omitted at fixtures, except where the superintendent's vigilance looks out for them. In the case of a very heavy water pressure in the supply system, I have found it an excellent practice to call for air chambers even on the supplies to flushing cisterns, as this tends to reduce the noise sometimes incident to the cistern fittings. Air chambers are especially needed where the faucets or ball-cocks used are of the ground key or Fuller pattern, for these close with a quick quarter-turn of the lever handle, and are apt to create considerable water hammer.

139. *Avoid all so-called "improved" secret waste and overflow fittings for basins and bathtubs.*

Where such have been selected by the owner, the superintendent can do no more than call his attention to their drawbacks from a sanitary point of view. Where the type of the basin and of the basin waste valve are not specially mentioned in specifications, the superintendent should exclude from use all "secret" wastes. It should be an axiom, particularly for washbasins in which the hands and the face are washed, that the water filled into the bowl should not come into even remote contact with any hidden passage, which, being inaccessible, cannot or will not be cleaned. The superintendent should give preference in all cases to basins with metal or porcelain plugs in the bottom of the bowl, operated by a fitting with handle placed outside and above the basin slab. Some forms of

standpipe overflow basins, while not so popular with house owners, are quite sanitary. There also are some good forms of siphon basins which either have no separate overflow pipe or which have an overflow passage which receives a good flushing out at every discharge of the basin.

140. *Urinals and water-closets to have local vent pipes or attachments only where the ventilation of the room in which they stand is either impracticable or omitted.*

Some plumbing regulations call for local vent attachments to such fixtures in all cases. My personal judgment is that a large register for foul air set in a flue which is made operative, by heat or otherwise, is far preferable to the comparatively small local vent flue attachment for water-closets or urinals. The superintendent should arrange for exhaust flues for all toilet and bath rooms. A plan which is both novel and practicable is to combine a number of such vent flues in the attic, place an electrically driven exhaust fan in a drum, and carry the wiring to every water-closet, placing a switch or button for turning on the electric current in reach of the occupant of the water-closet. He can thus regulate the ventilation of the bath or toilet room at will, and after the use of the fixture the air in the room will be found as pure as before.

141. *Low-down supply fittings for bathtubs should be avoided.*

While it must be admitted that such low-down or bell supplies are less noisy than nozzle discharges, and that they serve to protect tubs from injury (particularly the enameled iron tubs) because they cannot be used to fill pails or jars, they have the drawback and danger that the water in the tub may be drawn out while the bath faucets are open,

when water is being drawn at a faucet in the lower part of the building.

Low-down supplies should therefore always be provided with check valves on both the hot and the cold water pipes. Where the water pressure is very heavy this precaution may, possibly, be neglected.

142. *The superintendent should see that the fixtures delivered to the building are of the quality and style and of the make as specified.*

This paragraph is intended as a protest against the all-prevalent habit of some contractors of substituting for the goods or fixtures specified or selected by the architect or owner, others supposed to be "just as good." I frankly confess being unalterably opposed to any such practice. I hold that specifications should be rigidly adhered to in this respect. When an architect specifies a certain make of fixtures by name, it is nearly always done because he is familiar with their merits, has had previous experience with them, and by using such fixtures as have given entire satisfaction before, he tries to secure a good and acceptable job for his client. In those cases, again, where the owner has made a selection of fixtures at the plumbing supply stores, it is but just and right that he should receive in the execution of his contract work exactly what he has bargained for.

In this connection, let me say that I am aware of the unfortunate ruling, as given recently in the Supreme Court in a case, the litigation about which extended over a number of years. I do not pretend to know anything about law, and when I am told that a learned judge recently gave a decision which practically meant that it was proper, honorable and honest for a plumbing contractor to fit up

in a residence other goods than those for which the owner had contracted, I can only define my personal view by saying: — "This may be the law, but it does not seem justice." A decision such as this is all the more deplorable, to my mind, as it apparently encourages dishonesty and substitution. Plumbing fixtures, when selected by an owner, are to all practical purposes analogous to furniture, or to carpets, or to decorations. And who would say that a furniture dealer would have the right to substitute, without the owner's consent, other pieces for those bought by him?

Architects' specifications are, in a measure, at fault, and much to blame for this unfortunate condition of affairs. They usually read somewhat as follows: — The water-closet apparatus (or other fixture) to be *like* Pl. —— of Blank & Co.'s catalogue. The contractor, either in good faith, but more often with intention to defraud the owner, places a wrong interpretation upon the words "like Pl.", by claiming them to mean "similar to." Now there are, of course, cases where the architect's intention in writing the specifications is not to get just the fixtures illustrated in that particular plate of a certain make, but similar ones of a different — and generally cheaper — make. In order to prevent misunderstandings or intentional fraud, the architect should in this case not make use of the sentence "like Pl.", but he should use in preference the words "similar to, but of a different make." This practice, I am confident, would avoid any substitution of inferior goods in those cases where the intention of the specification is to give the owner just what he contracted for. Whatever the dictionary definition of the word "like" may be, I firmly believe that the meaning of this expression intended to be

conveyed in specifications is, that a particular fixture illustrated in a particular plate of a particular make should be used and no other. To avoid misinterpretation and trouble, it would be better in such cases to omit entirely the words "like Pl." and to say instead "the fixture to be Blank & Co.'s Plate ——."

I trust I may have succeeded in making the points involved in this paragraph clear, in order that young superintendents may apply the explanations given in their dealings with the contractors.

VII.

COMPLETING THE PLUMBING WORK, AND TURNING ON OF THE WATER AND GAS.

When all the plumbing fixtures are set and connected, it is desirable to get the water turned on at an early date, to discover minor leaks or imperfections, and to test the working of the fixtures. The filling and emptying of the basins, sinks and tubs must be tested, and the flush of the water-closets and urinals must be properly regulated. It is vastly better to do this long before a building becomes occupied, for only too often small imperfections, like leaky couplings, convey to an owner, who may happen to inspect his building at this time, a wrong impression as to the character of the workmanship of the plumber. In the same way, I favor having the gas turned on and the gas pipes filled with gas, even where the gas fixtures are not yet hung, for it gives an opportunity of detecting minor gas leaks. Indeed, the gas piping may have been repeatedly tested and passed as absolutely tight, but the pipes may have become strained or even broken when the floors are finished up. Serious gas leaks are sometimes discovered in this way, due to carelessness of other contractors, and it is surely better to find such faults before the house is occupied.

143. *Make sure that the waste pipe from the refrigerator is properly disconnected.*

No direct connection should exist between a waste from

an ice box or a refrigerator and the soil or drain pipe system. Such pipes should empty over a sink in the lower part of the building. The mouth of the waste pipe should have a brass hinged flap valve in order to exclude cellar air from the refrigerator. When this is done, a trap on the refrigerator waste becomes unnecessary, and it is well to do away with it, as it is liable to become stopped up. Some form of flushing arrangement should be arranged for the refrigerator waste pipe, as such pipes are apt to become covered up with slime from the impure ice. It is also a wise precaution to provide brass cleanouts on the waste pipe.

144. *All water-closet cisterns (as well as those of flushing-rim slopsinks and of urinals) should be so regulated as to fill up to near the overflow point; all ball-cocks are to be so regulated that the cisterns fill noiselessly and without spattering.*

This is an important matter which the superintendent should not overlook. In most cases, it is advisable to notify the manufacturers of the fixtures to send to the building to regulate their apparatus. In examining the cisterns of newly fitted up appliances, I find quite often that the same do not fill more than half way up to the overflow point, and of course this has an unfavorable influence on the flush. All ball-cocks should be well regulated; moreover, the matter of noise in filling is apt to assert itself in a disagreeable manner. See that hush pipes are provided to deaden the noise when the cistern is filling up. Where the pressure is very heavy, an air chamber on the supply to the cistern will accomplish some good, and by means of the shutoff valve, which should never be omitted, one is enabled to regulate the filling so that there will be no disagreeable spattering.

145. *All plated brass piping to be properly protected against damage resulting from the fumes of acids used in cleaning the tile floors.*

This point is sure to come up where there are tiled floors, and unless the superintendent looks out for the same there is apt to be considerable trouble from the acid fumes. I well remember a case where several hundreds of dollars' worth of damage was done to the nickel-plated work in several adjoining toilet-rooms, because the necessary precautions in protecting the completed plumbers' work had not been taken.

146. *All brass piping to be properly cleaned, rubbed and lacquered.*

Exposed brass and nickel-plated work is apt to tarnish badly in a new building on account of the dampness. It is a wise precaution to protect such work until the building is completed and turned over to the owner, otherwise the plumber will find himself out a good sum for repolishing such work. When the building is ready for occupancy, the plumber should be notified by the superintendent to attend to the very necessary cleaning-up process of his work. It is a good plan to apply a fine white lacquer to the brass piping after it has been polished and brightened up.

147. *See that plumbing pipes, other than brass pipes, are properly cleaned, painted, bronzed or enameled.*

This requirement is self-evident and calls for no further explanation.

148. *See that the smoke and vent flue openings for kitchen and laundry ranges are left in the proper position.*

Usually, the ranges are set towards the completion of the work. The superintendent should note the size and make

of the range specified, and find out where the above openings should be left in the flues.

149. *See that coupling joints and valve stuffing boxes do not leak at the fixtures.*

Such minor leaks cannot well be discovered before the water is turned on. It would be well for the superintendent to go through the entire building to make sure that there are no leaks of this kind.

VIII.

TESTS OF THE WORK.

Elsewhere I have emphasized the necessity of applying proper tests to the sanitary, hydraulic and gas piping work in buildings. In some cities such tests are now enforced by rules of building or health departments. But whether or not any tests of the work are made by municipal inspectors, I would advise a building superintendent to have all the required tests carried out under his personal supervision and direction. It is only by means of such tests that one can acquire any knowledge as to the character of the work executed, and as to the safety of a building from sewer air, from water leaks and from gas escapes.

Test of Soil, Waste, Vent and Drain Pipes.

150. *All rough work should be properly tested by the hydrostatic or water-pressure test.*

I have referred to this test elsewhere,* and have described how it is best carried out, and the directions there given should be ample to qualify a superintendent to direct a test, and to pass on the work.

Test of Gas Pipes.

151. *All gas piping should be tested by force pump and with mercury gauge.*

The gas piping of buildings is tested in many cities by the gas companies. In others, like New York and Boston,

* See "Sanitary Engineering of Buildings."

the test is made by building department inspectors. Certificates of tightness of the piping are issued by some gas companies. Whether the gas companies inspect and test such work in houses or not, it is the duty of the superintendent toward the architect's client to see that the work is tight. Those not acquainted with the proper method of testing the gas piping in buildings will find the necessary directions in the author's book, "Gas Lighting and Gas Fitting," as well as in some other books dealing with this subject.

Test of Supply Pipes.

152. *All supply pipes should be tested by hydraulic pressure pump to a pressure of at least* 80 *or* 100 *pounds per square inch.*

This test is easily applied where the plumber uses a good force pump, such as is specially manufactured for testing purposes. In this case, the pressure applied should be registered by a spring gauge.

Test of Completed Plumbing.

153. *A final smoke or peppermint test should be applied to the completed plumbing work.*

Specific directions on how to apply this test may be found in the author's book, "Sanitary Engineering of Buildings."

154. *Test whether all vent pipes on the roof are free and unobstructed.*

The best way to ascertain this is to apply a smoke test, and to watch the mouths of all pipes on the roof. Obstructions of the roof pipes are liable to occur, either through carelessness or by maliciousness, and it is well, before

accepting a plumbing job, that the superintendent should personally satisfy himself that the pipes are free and clear, for the ventilation of the entire soil pipe and drainage system depends upon the freedom of the roof pipes from obstructions.

155. *Test the fresh-air inlet to make sure that it is free and unobstructed.*

It is equally important to ascertain whether the fresh-air inlet is quite free, for this is intended to establish a current of fresh air through the entire house-pipe system. As at present arranged, there are numerous chances for the fresh-air inlet to become choked up, without this condition becoming apparent to the most careful inspector of the plumbing system.

Tests of Pumps.

156. *All pumps, whether they belong to the water-plant installation or to the drainage system (sump pumps), should be tested by the contractor, in the presence of the superintendent, when all the connections (the electric or steam and the water connections) are made.*

Except in the case of very large buildings, where it is becoming more and more the practice to use compound non-condensing pumps, or sometimes even compound pumps with condensers, it does not seem necessary to make duty or efficiency tests. What the superintendent has a right to find out by tests is whether the pumps installed are of the proper capacity, delivering the required amount of water to the house tanks placed at the given height above the pump. It is also necessary for the superintendent to make sure that the pumps work noiselessly and without vibration or pounding.

Where fire pumps are installed, as, for instance, in the case of theater buildings, a number of tests should be applied before the acceptance of the apparatus, such as a test for delivering capacity, a test for strength, and a test for available water pressure. The superintendent would do well to inform himself about the necessary tests of fire pumps by consulting the very complete specifications of the National Board of Fire Underwriters. These require that a fire pump set up in good order and properly packed should run smoothly, noiselessly, without jarring, slamming, jumping and hammering, at its full rate of speed with full length of stroke, and maintain the required water pressure in the fire lines.

In making these tests the water discharged by the pump should be sent through the lines of fire hose provided for. If the pump is a two-stream pump, it should be tested with two lines of hose; if a four-stream pump, with four lines, etc. The quietness of the hose would tend to indicate the degree of perfection of the pump; bad pulsations in the hose indicate a non-uniformity in the delivery.

The test for strength of a fire pump is made by closing nearly all the water outlets so that the pump moves but very slowly, and screwing down the safety valve hard. With steam admitted in sufficient quantity and pressure to give about 240 pounds water pressure, all joints in the pump should remain absolutely tight.

In the case of electric pumps with direct-connected motor it is well to make a test of the speed or number of revolutions per minute of the motor, and to find out whether at a given rate of speed the discharge of the pump comes up to the requirements of the specifications.

Tests of the Filters.

157. *The mechanical filter plant of a building should be tested as to its capacity and efficient working.*

In testing a water filter the point of prime importance is whether it delivers the volume of filtered water per minute or per hour as required by the specifications. In making this test it is well to apply spring pressure gauges on the piping on both sides of the filter and to compare the readings of the gauges, as a loss in pressure or static head of more than one or two pounds would indicate that the filter bed is of insufficient area. The superintendent should moreover ascertain whether the filters purify the water mechanically, *i.e.*, whether the water delivered into the white porcelain tubs or basins is of the desired crystal-like purity.

In addition, it is usual in the case of important buildings, to require certain chemical and bacteriological tests of the filtered water, which would be a criterion of the efficiency of the filters from a sanitary point of view.

Tests of the Hot-Water Heater.

158. *The apparatus for providing hot water, whether a hot-water boiler heated from the water-back in the range, or else a boiler iron tank heated by a special hot-water heater, or by a series of interior steam-pipe coils, should be tested by the contractor in the presence of the superintendent as to its capacity and proper working.*

The specifications usually require a certain number of gallons of water to be heated from a given temperature to another given temperature per hour, and before the hot-

water apparatus can be accepted it should be ascertained whether it fulfills the conditions. All large hot-water heaters and tanks, as well as the feed-water heaters used for hot-water supply, are nowadays provided with automatic thermostatic attachments for the regulation of the temperature of the water in the tank or heater, and the proper operation of these thermostats should be demonstrated to the superintendent's satisfaction.

Test of Hot-Water Circulation.

159. *In addition to the testing of the hot-water heater, it is necessary to make a test of the hot-water circulation system.*

In a properly laid out and constructed hot-water piping system with circulation, the water should be kept in constant motion from the source of hot-water supply to the remotest fixtures, and it should be possible to draw water of the required temperature almost immediately at any faucet in the building, no matter how far away from the source of supply. If the hot-water flow and return pipes have been run with proper grades, and if the superintendent has watched to see that there are no traps in the line, there will usually be no trouble about proper circulation of the hot water.

Test of the Flow of Water at the Fixtures.

160. *In a properly constructed water-supply installation there should be an adequate flow of water at all fixtures in the building when all or nearly all faucets are kept running simultaneously. Before accepting the work, the superintendent should carefully look into this matter.*

This is a matter not always easy to accomplish in the case of buildings having elaborate plumbing work, and it is particularly difficult to carry out when the fixtures or faucets are supplied under street pressure, for in this case the question of the size of the tap or branch from the water main has much to do with the volume of water delivered through the house service pipes. Unless the water pressure in the street main is very strong, and unless the tap and house service are of good size, it quite often happens that the opening of faucets on the lower floors will prevent the water from flowing at the faucets in the upper floors.

Where there is a roof-tank or pressure-tank supply, the object sought for is much more readily obtained, provided large supply mains and branches of suitable size are used through the building.

Tests of the Water-closets and Urinals.

161. *The water-closets and urinals should be tested after being installed as to their proper working. The flushing should be efficient and noiseless.*

It belongs to the superintendent to make a personal test of all the water-closets and urinal fixtures installed in a building. He should see that the length of the flush is properly regulated so as to clean the bowls properly, yet not waste any water. In this connection he should examine the water level in all flushing tanks and see that the ball-cocks are regulated so as to close when the water reaches to a point within one inch of the overflow in the flushing tank. Moreover, it is necessary to test the proper discharge or siphonage of the water-closets, as there will be found among a large number of such fixtures a few which do not carry out solid matter dropped into the bowl. The test

should be made by applying the proper quantity of toilet paper; but in some cases severer tests, such as dropping a quantity of ashes or corks, or other substances, into the bowl, are applied. Siphon jet urinals should be tested in a similar manner. All water-closets and urinals which do not promptly remove such matters as are apt to be delivered into the bowls should be rejected and condemned by the superintendent.

Tests in General.

162. *From a long experience in a large number of buildings devoted either to residential or to commercial, educational or institutional purposes, the author has become convinced that one of the most important duties of a building superintendent consists in having all installations of interior work (whether electric, heating and ventilating, or hydraulic, sanitary or gas-pipe installations) properly tested.*

The tests should in all cases be carried out by the contractor or sub-contractor who has undertaken the particular work of installation referred to. All expenses connected with such tests, except those for expert supervision, should be borne by the contractor. Moreover, wherever after applying a test to a particular work of construction there should be any doubt felt in the mind of the superintendent as to the soundness of the work or installation, or as to its efficiency, he should insist upon a repetition of the test.

As far as practicable the sewer, water and gas connections should be tested. Next in order is the test of the drain, soil, waste and vent pipe system, including all branches up to the fixtures. All water service pipes and likewise all gas piping should be thoroughly tested and

proven to be tight to the satisfaction of the superintendent.

When the entire installation is completed, a smoke or oil of peppermint test of the entire plumbing work should be made. Finally, the various parts of the mechanical equipment for the water supply should be subjected to such tests as the contract may require and as the superintendent may, at his discretion, direct.

IX.

RECORDS AND PLANS.

A correct record or plan of the drains, and of the water and gas pipes in a building, is of inestimable value. I should, therefore, advise young superintendents to employ their leisure moments in taking such notes and records as will enable them to make all required changes — where such have been made — in the plans. As regards the drainage, it is best, for large buildings, to make a new, correct plan, in which everything is entered or shown, which may be of value in future examinations or alterations. In particular should all underground work, or work necessarily covered up, be correctly noted on the plans. From personal experience I can testify to the great value of a correct drainage plan of a building. It will often save much time and expense to the owner.

Even though the water pipes are usually kept exposed, it is important to keep a general plan and a diagram showing the system of water distribution, the location of stop-cocks and shut-off valves. In the best work it is, to-day, the rule that a printed list of the numerous valves is made, which gives their number, location, and the purpose for which the valves are to be used.

Last, but not least, where the gas piping of a building is extensive, a plan should be prepared showing the run and distribution of these pipes, or at least the position of the principal lines and risers, and their shutoffs.

I should perhaps point out that it is well-nigh impossible to make such record plans after the building is completed, but they should be made, or at least the notes entered and kept, during the progress of construction.

CONCLUSION.

It is not the intention of these suggestions to teach a superintendent even the rudiments of the sanitary, hydraulic and gas piping work in buildings, but rather to call attention to numerous questions which come up during construction, and which the superintendent, in the absence of the architect, will have to decide. It is not claimed that what has been said covers *all* the points. Doubtless some matters have been omitted or overlooked. Nevertheless, it is hoped that the suggestions and comments made will prove of assistance to building superintendents, inspectors, young engineers, to owners, and others engaged in such work.

ADDITIONAL NOTES.

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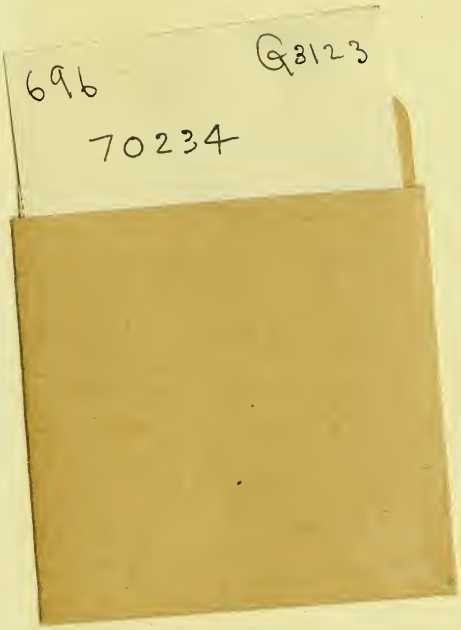
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